Diagnosis of Skin Melanoma Cancer using Image Based Computer-Aided Diagnosis System from Dermoscopic Images

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Abstract— Skin malignant growth is the most widely recognized, everything being equal. Between 40 to 50 percent of all disease cases analyzed each year are skin malignant growth. Melanomas represent just four percent of all skin malignant growth cases yet are undeniably more perilous. Of all skin disease-related passing's, 79 percent are from melanoma. Skin disease can be relieved if distinguished early. To appropriately distinguish melanoma, there is a need for a skin test. This is an obtrusive method and is the reason there is a requirement of a conclusion framework that can annihilate the skin test strategy emerges. We proposed to build up a Computer-Aided System that is equipped for ordering a skin injury as threatening or favorable by utilizing the ABCD rule which represents Asymmetry, Border, Color, Diameter of the skin sore. Further, the preprocessed pictures are portioned and commotions are taken out from the Dermoscopic pictures for instance hair and air bubbles. Also, finally, by utilizing a classifier, the proposed system identifies the pictures as favorable or harmful.

Index Terms— Melanoma, Skin Cancer, ABCD rule, Biopsy, Skin sore, Dermoscopic

I. INTRODUCTION

Skin malignancy is a deadly infection such as reality undermining. As of late, skin disease has gotten perhaps the deadliest types of malignancies found in individuals. Out of the relative multitude of different kinds of skin malignancies, melanoma tumors are the most generally perceived kind of skin illness and are the most unconventional in the world. Melanoma skin cancer has become so unsafe that it is growing in many numbers among people and causing unhealthiness to them. Melanoma also referred to as malignant melanoma, is a result of variation between the cells from pigments that give color to our body. This disease may arise from a mole and it may give rise to

some changes such as an increment for dimension, Irregular boundary, and a change in shading, skin damage, or bothering. Doctors say that the unveiling of the body to the sun as in the UV radiations or tanning beds for a longer duration causes harm to the DNA of our skin cells, which disturbs their normal function and makes them grow uncontrollably. Melanoma skin cancer is so harmful that if not detected at an early stage it could spread to the whole body, and can be the cause of a patient's death. It is perhaps the most capricious skin malignancies and hence identification of melanoma disease at the beginning phases could help in restoring it rapidly and proficiently. The difference between a benign and malignant sore can be found using ABCD (Asymmetric, Border irregularity, Color, Diameter) rule. A benign melanoma infrequently spreads in the body. Examples of benign melanoma are a mole or a birthmark. Malignant melanomas are irregular in shape, have no symmetry, there is no specific color to be determined.

II. LITERATURE SURVEY

A worldwide temperature alteration has expanded the force of solar radiation which has prompted ascending of skin melanoma malignant growth in individuals. Melanoma can be relieved on the off chance that it is distinguished in the beginning phases. The conventional way to deal with melanoma skin malignant growth discovery requires a biopsy, an obtrusive strategy that can be an excruciating, expensive and late process. Along these lines, the need for a computerized system that can identify melanoma cancer precisely is a need in the clinical domain. Melanoma scan exists in fluctuated forms, shadings, and dimensions which makes it difficult for identifying cancer at the beginning phase which is the reason it is fundamental to plan a framework that considers appropriate highlights for extraction. Analysis of skin melanoma cancer utilizing a mechanized framework incorporates the following steps:

- 1st Step: - Image Acquisition: Collection of Dermoscopic image datasets
- 2nd Step: - Image Preprocessing: Removal of noises and distortions from the input images.
- 3rd Step: - Image Segmentation: Segmenting preprocessed images from infected and non-infected portions.
- 4th Step: - Feature Extraction: Extrication of nine features established from the ABCD rule.

- A- Asymmetry: Malignant sores are asymmetric in shape.
- B- Border: Malignant sores have irregular borders.
- C- Color: A malignant sore usually consists of black, white, red, blue, or brown tones.
- D- Diameter: A malignant sore is often bigger than 6 mm in diameter.
- 5th Step:- Classification: Skin sore is classified into two categories, benign and malignant.

[3] S. mane et al. proposed a framework where the original shading skin picture is chosen from the dataset. Chosen original shading skin picture is changed over into a grey shading picture. The skin picture contains a few hairs which will corrupt the precision of characterization. So, hair expulsion is finished by utilizing the Gaussian channel. The hair eliminated picture contains the sore part alongside the sound part. For acquiring just, the sore part segmentation is performed. In the subsequent stage, highlights are extricated from the divided sore. In feature extraction, all 10 features are extricated in which edge, zone, anomaly, contrast, relationship, energy, homogeneity, and shading are the features. These features are given to the SVM classifier [3]. Results are gotten utilizing shading, shape, and surface highlights. Sensitivity, specificity, and accuracy are registered by utilizing an SVM classifier. It is seen that the SVM linear function gives [3] greater affectability and precision than the SVM RBF kernel. If there should arise an occurrence of explicitness SVM RBF kernel performs better compared to SVM linear function [3].

[4] S. Majumder, et. al proposed a framework that considered more features from the essential ABCD rule. It takes 200, 8-digit RGB color Dermoscopic pictures with a resolution of 768560 as an input dataset, containing 160 4 favorable and 40 harmful melanomas. These images were taken from a PH2 dataset which contains skin sores of every single distinctive shape, tone, and size. Image resizing and contrast change were the steps involved with image preprocessing. To reduce noises like hair or air bubbles from the Dermoscopic images an RGB filter is applied to the images to clear the view. Otsu's thresholding method was used to segment the images and after this work, a concealing effect is applied to reduce mass from the images. The feature extricated is established from the ABCD rule of Dermoscopic and also Backpropagation Neural Network (BNN)is used to classify the uploaded picture as a benign sore or malignant sore [4].

[5] K. Eltayef, et. al also proposed a framework that zeroed in on different image pre-processing and image segmentation strategies [5]. In image pre-processing step it included two key activities: hairs, reflection artifact detection, and removal [5]. To distinguish any noise like air bubbles, a straightforward threshold method is applied. A bank of 64 directional filters has been utilized to play out hair detection [5]. The picture is filtered by each directional filter with various parameters and the distinction of Gaussians is utilized by tracking down the nearest greatest at every pixel area [5]. In this way, the threshold method is applied to arrange every pixel as one or the other hair or background [5]. After reflection artifacts and hairs are identified, their binary conceals are increased by greyscale pictures. This framework utilized a two-venture division: Markov Random Field (MRF) and Fuzzy c-means (FCM)[5].

[6] O. Murumkar et al. proposes a system consisting mainly of 2 components a. Image segmentation b. Feature Extraction. Thresholding, edge-based, and region-based methods are used to perform image segmentation; also the proposed framework comprises Otsu's division strategy [6]. The feature extricated is established from the ABCD rule of Dermoscopic[6]. The ABCD represents Asymmetry, Border structure, Color variety, and Diameter of the sore. In the second period of feature extraction, four highlights (Asymmetry, Border, Color Variation, and Diameter) are separated [6]. By utilizing the beneath equation for the figuring of Total Dermoscopic Value (TDV), the value TDV is resolved. On the off chance that TDV discovers to be > 5.45, Melanoma sore disease is identified [6].

[7] H. Mhaske et al. took 150 pictures from online sources and division is performed. In the Thresholding technique peak value for the skin and peak value for the sore is resolved and afterward limit is chosen in the middle of these two peak points [7]. The pixel intensity values that are more prominent than the threshold value is set as 0 while intensity values that are not as much as the threshold value are set as 1[7]. For segmentation of skin malignant growth pictures region growing and merging techniques is utilized. Feature extraction is finished utilizing two wavelets [7]. An original picture is isolated into four sections from the outset level of decomposition. Each part addresses the feature and two degrees of decomposition are done to get the highlights [7]. In the second degree of decomposition out of four sections again each part is separated into four sections so complete 16 sections are created [7]. And afterward, high pass and low pass filters are applied to the picture. The features are gotten utilizing boundaries like mean, median, standard deviation, minimum, variance, and maximum [7]. Classification of pictures into malignant growth type and skin type or non-disease type is finished supervised and unsupervised learning [7]. Neural Network classifier, k-means clustering algorithm, and SVM(Support Vector Machine) are utilized to order the sores[7].

[9] M. A. Sheha, et. al encouraged a framework that utilizes surface examination that disposes of the segmentation step [9]. It had a total of 102 dermoscopy images dataset which comprised of 51 images of each benign and malignant melanoma on which picture resizing is applied of 512×512[9]. Also, the transformation from RGB to a grey level where the features are dependent on the grey level co-occurrence matrix is done [9]. The features separated are as per the following: Correlation, Contrast, Cluster Prominence, Homogeneity, Dissimilarity, Difference entropy, Difference variance, Information measure of correlation, Information measure of correlation, Inverse difference homogenous, Inverse difference moment normalized, and Inverse difference normalized. Multilayer Perceptron (MLP) is used to classify them afterward [9].

[10] A. G. Isasi, et. al put forward diverse pattern's recognition algorithms dependent on the idea of skin disease [10]. Three features which are reticulated, globular, and blue pigmentation are Identified as these occur repetitively in harmful melanoma skin cancer [10]. These features are extricated from pattern recognition algorithms [10].

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Table I: Comparison of existing method and proposed method for feature extraction

Author	Paper Name	Feature Extracted
S.Mane And Dr. Shinde[3]	A Method for Melanoma Skin Cancer Detection Using Dermoscopic Images [3]	Irregularity, Color Perimeter, and texture feature Extracted from skin image, Area [3].
Nadia Smaoui Zghal, and Nabil Derbel[1]	Melanoma Skin Cancer Detection based on Image Processing [1]	Border, Asymmetry, Diameter [1].
Vijayalakshmi M M[2]	Melanoma Skin Detection using Image Processing and Machine Learning [2]	Size and Texture, Shape, Color [2].
Ms. H.R.Mhaske, Mrs. D. A. Phalke[7]	Melanoma Skin Cancer Detection and Classification Based on Supervised and Unsupervised Learning [7]	Median, Mean, Variance, and Calculate Minimum, Maximum, Standard Deviation of image vector [7].
AH Bhuiyan,Uddin, Ibrahim Azad, Md Kamal[8]	Image Processing for Skin Cancer Feature Extraction [8]	Colour Variegation, Diameter, Asymmetry, Border [8].
Omkar Murumkar, Prof.Gumaste P.P[6]	Feature Extraction for Skin Cancer sore Detection [6]	Diameter of the sore, Border Structure, Asymmetry, Color Variation [6].
Khalid Eltayef, Yongmin Li, and Xiaohui Liu[5]	Detection of Melanoma Skin Cancer in Dermoscopic Images [5]	Diameter, Color Variegation Asymmetry, Border [5].
Mariam A.Sheha ,Mai S.Mabrouk, Amr Sharawy[9]	Automatic Detection of Melanoma Skin Cancer using Texture Analysis [9]	Prominence, Dissimilarity, Contrast, Correlation, Cluster Homogeneity, Difference variance [9].
Gola Isasi, Garcia Zapirain, Mendez Zorrilla[10]	Melanomas non-invasive diagnosis application based on the ABCD rule and pattern recognition image processing algorithms [10]	ABCD Feature along with feature extracted from pattern recognition algorithm [10].
Majumdar and Ullah [4]	Feature Extraction from Dermoscopic Images for an Effective Diagnosis of the Melanoma Skin Cancer [4]	Difference Between Maximum and Minimum Feret's Diameter Asymmetry, Border, Color Variegation, Irregularity, sore Diameter [4].
Proposed System	Diagnosis Of Skin Melanoma Cancer Using Imaged-Based Computer-Aided Diagnosis System from Dermoscopic Images.	9 features from ABCD rule as A1- asymmetry along the x-axis, A2 - asymmetry along the y-axis, B1- area perimeter ratio, B2- compactness index, B3- a product of area and perimeter, C - live contour, D1- an average of the diameters of the sore, D2 - the difference between the smaller and larger axis, D3- diameter of the sore.

III. PROPOSED WORK

There are mainly 6 steps proposed in our system. The first step is Image acquisition where we have collected a PH2 freely accessible dataset. The second step is Image preprocessing where the Dermoscopic images are preprocessed and any noise or malformation is removed to make focus on the infected region in the image. The third step is Image segmentation where the uninfected part is segmented from the infected part in the Dermoscopic images. The fourth step is feature extraction in which 9 features from ABCD rule as A1- asymmetry along the x-axis, A2 - asymmetry along the y-axis, B1- area perimeter ratio, B2- compactness index, B3- a product of area and perimeter, C - live contour, D1- an average of the diameters of the sore, D2 - the difference between the smaller and larger axis, D3- diameter of the sore. And the last step proposed is Classification, classification of the images using a neural network classifier.
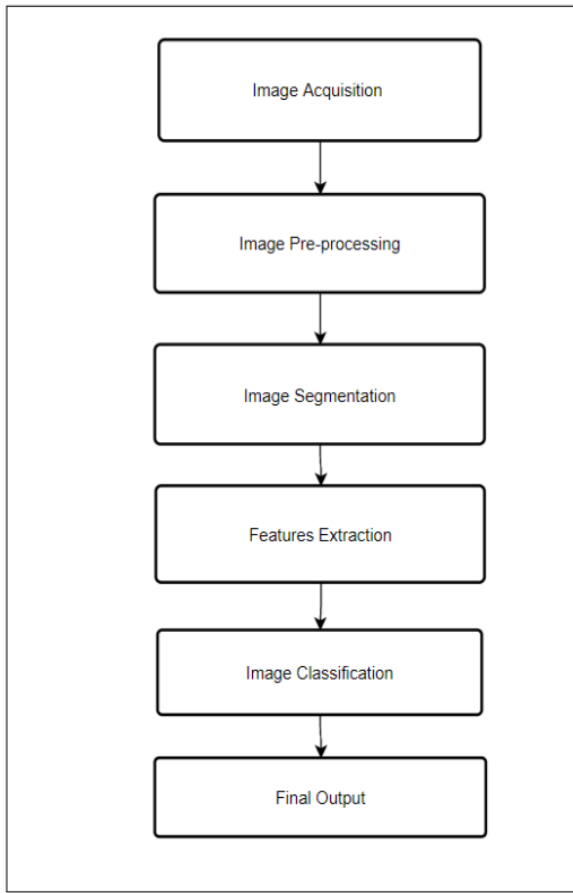
Figure 1: Flow Diagram

01. *Image Acquisition*

The Ph2 database is a freely accessible data set of Dermoscopic images given by Pedro Hispano Hospital. From this data set, 200 melanocytic images were gathered which comprises 160 favorable and 40 harmful sores.

02. *Image Pre-processing*

Before extracting features and classifying the images as benign or malignant the images are first pre-processed so that the noise like air bubbles and hair are removed from the image to get a clear image for segmentation purposes. First colored images are converted into grayscale images than to increase the efficiency of the system, the morphological operation is applied to the images. After morphological filtering is done blackhat filtering is applied on the images to enhance the darkened areas of the images to focus on. At last, an inpainting algorithm is used to reduce the hair visibility from the images by highlighting the part which has hair contours. It helps in restoring the background of the image without hairs.

03. *Image Segmentation*

Segmentation is carried out to separate the region of interest, basically the infected portion from the uninfected portion of the skin sore. Here, for segmentation mainly two algorithms are used (a) Otsu's thresholding method (b) Chan-vase model. Otsu's thresholding method separates the background from foreground pixels into different classes by using the bi-modal histogram. And using this image as input to Chan-vase, it uses a contour model which separates the foreground and background once it reaches the border.

04. *Feature extraction*

After image preprocessing and segmentation, we extract appropriate features from the images. Using the ABCD rule, we continue to extract 9 features from the images.

a. *Asymmetry*

In malignant sores usually, sores are not symmetrical. Here we calculate to seek out if bisection of the sore is symmetric to the opposite bisection of the sore or not. For calculating this, the image is aligned with the euclidean system, and the center of the segmented picture is taken as the center of the reference system. Now, the image is rotated so that its x-axis aligns with the larger axis of the coordinate system. Further, the image is flipped along the x-axis. The difference between these two provides the well-separated region along the x-axis. Similarly, calculated with the y-axis.

b. *Border*

The contour of the blob is defined by the border. A malignant sore has a highly irregular shape and no visible border to be defined. Here the area is to outer edge ratio, density index, and the multiplication product of area and outer edge are calculated to calculate B1, B2, and B3 respectively. B1 values are rather small, B2 determines the felicity of the edges and spans from one to zero and B3 values are bigger.

c. *Colour*

The segmented image is applied as a conceal on the colored image as a result we get an RGB colored segmented image. The RGB threshold values are calculated for dark brown, black, light brown, red, white, and blue-grey colors from the picture and the picture is then converted into an HSV color space. Each color is used as a conceal. On the HSV image bitwise AND operation is carried out to find the color conceal and the live contours. If the live contour value is larger than 0 then the color is present or else not. The color score spans from 1 to 6 as there are 6 colors supposed to be there in the skin sore.

d. *Diameter*

Malignant melanoma may have a diameter larger than or equal to 6 mm. D1- an average of the diameters of the sore, D2 - the difference between the smaller and larger axis, D3- diameter of the sore. is calculated.

05. *Classification*

After extracting the 9 features from the segmented images it is time to classify them. Here we use a sequential artificial network. Adam classifier is applied to classify them as benign or malignant. First, some sample dataset from the dataset available is fetched as input to the model as training data to train the model. After the model is trained, the remaining dataset is fetched as testing data to the model to predict the sore as malignant or benign. In this way, the model is trained

and the system detects melanoma skin cancer efficiently.

IV. CONCLUSION

The escalating rise in melanoma skin cancer patients is a very serious issue to be noted. This issue is grave because melanoma is one of the skin cancers which can spread to other skin cells nearby and can escalate at a very high speed sometimes causing the death of the patient. If this cancer is detected at an early stage, then it can be cured. The conventional methods used to detect melanoma are very expensive and painful. So, for this reason, there is a demand for a computerized system that can effectively detect melanoma at an early stage by evaluating the Dermoscopic image of the sore. Our proposed system proposes to do alike by using 6 steps in general on the Dermoscopic image dataset PH2 which is publicly available. The six steps are image acquisition, image preprocessing, image segmentation, feature extraction, Image classification, and final output. Our system uses a neural network and machine learning algorithms to detect melanoma at an early stage. Although, there are some regions in this study that are to be identified and taken into consideration. One of them is that dark-colored people's sore images are difficult to be segmented and extrication of features is also a difficult task. To increase the efficiency of the system we would like to add more real-time datasets from hospitals that detect melanoma by conventional methods.

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